



August 12, 2005

Ms. Moya Thompson, Director
Outreach Coordination
White House Conference on Aging
c/o Administration on Aging
Department of Health and Human Services
Washington, D.C. 21201

Dear Ms. Thompson:

I am pleased to submit the National Space Society International Space Development Conference report pertaining to presentation topics which addressed issues of interest to older citizens. This event was held May 19-22 in Arlington, Virginia at the Sheraton National Hotel.

The Conference was very successful, with topics ranging from the history of space exploration to new initiatives for future exploration. An important segment of the conference was how space research and technology development benefits life on earth for all generations. A number of panel members also noted in the "benefits" sessions how research conducted to enable astronauts to live and work safely in space, particularly as part of long duration exploration missions, has a direct link with efforts to improve life on earth: telemedicine, bone and muscle research, etc. Two panels with a total of 16 panel members focused their talks on the benefit of space exploration to life on earth. This report provides information on a number of panel presentations of direct relationship to issues associated with aging. There is also a brief discussion on how the broadening of the space experience to greater sectors of the public beyond the ranks of the astronaut corps, can and should include participation by older citizens.

If you have any questions, please contact me at 202-429-1600, or by e-mail: george@nss.org

A handwritten signature in black ink, appearing to read "George Whitesides". The signature is fluid and cursive, with a long horizontal line extending to the right.

George Whitesides
Executive Director
National Space Society

Post Event Summary Report

Name of Event: 2005 International Space Development Conference

Date of Event: May 19-22

Location of Event: Sheraton National Hotel, Arlington, Virginia

Number of People Attending: 800 registrants to conference; ~ 50-75 total attendees for the “Benefits” sessions

Sponsoring Organization: National Space Society, NASA, and other organizations

Contact Name: George Whitesides

Telephone Number and E-Mail:

EVENT SUMMARY:

The National Space Society 2005 International Space Development Conference addressed a wide variety of topics, ranging from the history of spaceflight, to human and robotic exploration goals and objectives, to innovative space transportation systems that only a few years ago would have been relegated to “Jules Verne” type novels. One of the themes of this conference included the benefits that space research and development have to improving life on Earth, for all generations including older citizens. One specific contribution made by space research has been the manner in which physiological changes that take place in the microgravity environment of orbiting the Earth, whether through the Space Shuttle or International Space Station, mimic in accelerated fashion changes that take place on Earth among patient populations or older citizens. Treatment and monitoring technologies which benefit astronauts have a direct correlation to supporting improved medical treatment on Earth.

Health Care Issues and Benefits of Space Research

Priority Issue #1: Countermeasures for physiological changes brought on by aging and/or disease, and by the challenges of spaceflight

Problem Statement: As part of the aging process, or as the result of disease, there are a number of changes within the body that pose significant challenges. There is a corollary to changes in the human body during spaceflight:

- Vestibulo-spatial deregulation
- Sarcopenia/muscle atrophy
- Cardiovascular
- Immune System
- Sleep and Biological Rhythms (pattern changes as part of the aging process; in low Earth orbit, a 90-minute orbital “day” adaptation for astronauts)
- Pharmacokinetics

- Radiation and the impact on DNA repair and oxidative stress
- Confined/closed environment and stress interactions
- It takes 40 years on Earth to lose 25% of bone mass; this phenomena occurs after 40 months in a microgravity environment of low earth orbit in space. It takes 25 years to lose a specific level of muscle mass, a level of loss that is reached after 25 months in microgravity conditions of low Earth orbit in space.

Solutions: Use insight gained through space exploration to develop countermeasures for astronaut health, and for terrestrial application.

There has been substantial research sponsored by NASA, and other federal agencies such as NIH, to link research in space for astronaut health, with improving the quality of life on Earth. Through Space Shuttle missions such as the NEUROLAB mission/STS 90, as well as life science experiments conducted on STS 95, extended microgravity research on the Russian Mir Space Station, and now on board the International Space Station, areas of life science research undertaken in space and used to advance medical research on Earth include, but are not limited to:

- Neuroscience
- Spatial Orientation
- Musculoskeletal biology
- Immunology
- Cardiovascular Functioning

Future space missions can continue to advance an understanding of the aging process:

- Are the mechanisms responsible for the physiological changes in space the same as occur during aging?
- What implication does the reversal of these changes following space flight have for understanding age-related changes?
- Can interventions developed for spaceflight be used for aging on Earth, and vice versa?

Recommendation:

There has been a long history of linking space exploration with broadening our insight into life science research on Earth. While recognizing that NASA has sharpened its focus on the ambitious exploration goals that lie ahead in robotic and human exploration, there remain significant contributions that space exploration research and technology development can make to improving life on Earth for all generations, and particularly those areas of research such as identification and treatment of disease, and the mitigation of the aging process. The collaboration fostered to date among agencies involved in linking space research to benefiting life on Earth should be continued.

Priority Issue #2: Telemedicine and the Challenge of Remote Medical Care

Problem Statement: Astronauts, particularly those engaged in long duration missions, are removed from the range of medical support systems available on Earth. Disease or injury could pose mission-threatening challenges, even where relatively minor medical issues are complicated by lack of access to suitable facilities. This challenge faced by astronaut crews has some parallel to medical problems confronting populations in remote regions of the world with limited access to medical resources, or in natural disasters or human conflict, where medical capabilities and infrastructure may be overwhelmed.

Solutions:

Telemedicine and remote medical care, the ability to monitor and assess human health indicators and to act on such information independent of other medical support systems, is essential for astronaut well-being particularly for long duration exploration missions where crew members must rely on each other as primary caregivers. Non-invasive diagnostic imaging and ultrasound technology along with supportive communication can provide a crucial link between the exploration crew and medical expertise on Earth. Advances in medical technology will also support autonomous medical care by and for crew members. This is a clear corollary to health care provision via telemedicine and autonomous medical capability provision on Earth particularly in remote regions or where medical infrastructure has been damaged or destroyed by nature or human conflict. There have already been a number of terrestrial medical applications developed as a result of non-invasive diagnostic and telemedicine technology development for space:

- Medical telemetry for intensive and cardiac care units
- Pilot telemedicine projects in developing nations, and in the deployment of mobile medical field units.
- Bone density measurement for the diagnosis and therapy to prevent fractures in people with osteoporosis
- The use of ultrasound to monitor astronaut health, which also has significant application in terrestrial non-invasive determination of medical abnormalities (pulmonary, musculo-skeletal, dental/sinus/urologic disorders/cardio-vascular, and abdominal) brought on by disease or injury.

Recommendation:

- *Telemedicine is a vital tool for exploration. It also has significant terrestrial application on Earth, to remote locations or in the event of natural or conflict occurrences, particularly among vulnerable populations such as those afflicted by disease or the challenges of advanced age. Therefore, there needs to be continued support for telemedicine and autonomous medical care research and application, to include interagency collaboration among federal agencies such as NASA, NIH, FEMA, and DOD.*

Priority Issue #3 Sex and Gender-Based Research:

Problem Statement: Many of the physiological changes that occur during space travel are similar to what is experienced during the aging process on Earth. From the microcosm of space, sex-based differences have a significant impact on our national mission of space exploration. Without a concentrated and integrated focus on the impact of sex on fundamental biology and biomedical science, we will remain unable to achieve fundamental health care goals, maintain an efficient work force and meet the demands of an aging population. Given the fewer numbers of women who have flown in space, there is also a need to obtain more data from women astronauts to build on the existing database. The range of life science research includes the following fields; some have already yielded important data, while other research areas require much more study:

- Musculoskeletal
 - Sarcopenia: Rates of loss in men parallel those in women on Earth, while decrements in muscle strength are greater in men.

- During spaceflight, pooled data from men and women astronauts reveal significant loss in muscle mass after only 11 days of spaceflight.
- Flight and bed rest data on female astronauts and bed rest subjects are quantitatively and qualitatively deficient; more research and data compilation needs to take place.
- Cardiovascular
 - Women have less tolerance to upright posture or gravitational stress than men primarily due to a reduced ability to maintain venous return and cardiac output.
 - Mechanisms responsible for blood pressure control and variance between men and women have not been identified.
 - Women respond to cardiovascular stress with increased heart rates, while men respond with greater increases in vascular resistance.
- Immunological
 - No studies have taken place to evaluate the link between gender and the immune system status in microgravity.
 - On Earth, resistance to infectious diseases, immunizations and cancer, and development of autoimmune disease are greatly influenced by gender.
- Neurovestibular
 - Virtually nothing is known about links between gender and vestibular and balance disorders under variable gravity conditions.
 - Most clinical laboratories report that women evidence symptoms of imbalance and disequilibrium at a rate of 2 to 1.
 - Females are at higher risk for motion sickness during space adaptation than their male counterparts.
- Human Behavior
 - No significant gender differences were observed in the 10 factors important for long duration flight.
 - Mixed gender groups operate more smoothly than only a single individual, male or female, under confining environments.
 - Some studies report that women believe they have to work harder than men in relation to workload issues.

Solutions: Support for further sex-based research on adaptation to the space environment will provide important information for future crews of men and women astronauts as they prepare for long duration missions exceeding any journey taken to date. Such research will also add to the base of knowledge regarding medical issues of interest and concern to men and women on earth, including older populations who are more likely to be confronted with physiological challenges as they age.

Gaining insight into how men and women adjust to variable gravity conditions and other aspects of spaceflight may advance our understanding of how men and women differ in their reaction to the environment on Earth at all ages, including the environmental effects on the aging process. Changes in muscle mass, bone density, the immune system, and spatial orientation/balance take on added meaning and impact as part of the aging process as individuals are more likely to be confronted with physiological challenges as they age..

Recommendations

- *There needs to be multi-agency initiatives focusing on sex and gender based research which would include but not be limited to NIH, NASA, DOD, and NSF.*
- *There needs to be a tissue and databank established for sex and gender based research purposes.*
- *There needs to be educational opportunities for scientists, clinicians, and the general public to learn more about sex and gender based medicine.*

Priority Issue #4 Adaptation of Space Research for Terrestrial Medical Application

Adaptation is an important factor in applied research, where advances in one field may foster new or improved processes or results in another field. There have been several examples of research and technology developed originally for one space-based objective, later discovered to be very useful in addressing a challenge in a different field of endeavor such as medicine, including research in the treatment of diseases.

Problem Statement: Invasive forms of treatment, such as surgery or powerful drugs, may have side-effects or trauma to the body.

Solution: Advances in Non-Invasive Treatment Using Technology Gained From Space Research/Light Treatment for Eye Disease:

Recent research has demonstrated the adaptation of technology from space-based purposes, to medical procedures on earth. Light emitting diode (LED) technology, once designed for plant growth and research in closed environment systems for spaceflight, can be applied towards wound healing and treatment of some forms of eye disease. Such research also reflects growing interest in non-invasive methodologies of treatment as a viable alternative to surgery.

- Near infrared light therapy is non-invasive and stimulates the cells' own potential for repair. Light in the far red to near infrared region of the spectrum has been shown to promote cell survival and wound healing.
- Near infrared light stimulates mitochondrial cytochrome oxidase, an important regulator of cell function. Mitochondrial dysfunction plays an important role in cellular aging and degenerative diseases: cardiovascular disease, eye diseases including macular degeneration and glaucoma, and metabolic disease such as diabetes.
- LED technology has shown promise in cancer tumor treatment, using light to activate chemicals that attack the tumor while not affecting healthy tissue.
- Promising research has also been seen in wound healing therapies using a light source

The use of light as a treatment therapy will not only benefit patients on earth, but may also be applied back to the space program as a countermeasure against the effects of long duration exploration missions in variable gravity conditions including wound healing delay and immune deficiency.

Recommendation

- *Research associated with light therapy should be supported and information shared among federal agencies including but not limited to NASA, NIH, NSF, and organizations within DOD.*

CONCLUSION

There are significant challenges associated with human spaceflight and exploration; in physiological changes to bone and muscle, balance, remote health monitoring and medical diagnostic analysis of the crew. There is a substantial corollary between these factors and terrestrial medical research to address general health concerns and in terms of changes to bone, muscle, balance, etc., to aging populations in particular. Human space research may also provide insight into models and profiles for early and mid-life preventive measures for persons in high risk categories for degenerative illnesses, allowing the charting of a path for avoidance and prevention of these diseases for aging persons. This work should be continued by NASA, NIH, and other agencies involved in research that may improve the quality of life.